DEVELOPMENT OF A COMPUTERIZED AIRCRAFT WIRING MAINTENANCE AID

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THE NEED

- ***B-1 Live Fire Test & Evaluation (LFT&E) Program - Aircraft Battle Damage and Repair Report - B-1 Fuselage*, AFRL-VA-WP-TR-1998-3064, April 1997**
  - **"Also, the repair crew stated the difficulty in tracking the wires to their different systems. This difficulty stresses the importance of wiring repair. The conduits are also sensitive to electromagnetic impulses. Thus, wiring repairs essentially require extra time for proper repairs." - page 37**
  - **"Also, the B-1 specific TO (1B-1B-39) contained no wire repair guidance. The repair crew stressed how time-consuming wire tracking can be and its importance." - page 52**
  - **"The B-1 aircraft has an immense amount of wiring. Tracking and repair can be time-consuming." - page 55**

THE NEED (cont)

- ***Battle Damage Repair Of Tactical Weapons: An Assessment*, Report RE801R1, Logistics Management Institute, August 1989**
  - **"The M1 live-fire tests took place from August 1987 to July 1988 at Aberdeen Proving Ground, Maryland. … The most significant problem uncovered during this BDAR experience was the difficulty in repairing electrical wires, which are marked on the M1 only at the connector (6 - 12 inches away)." - page B-17**

MORE DATA

- **Aircraft Wiring Battle Damage Assessment And Repair Biggest Factor Keeping Aircraft On The Ground**
  - **Median Time To Assess And Repair Wiring Damage In Southeast Asia Was 650 Hours vs 21 Hours For Structural Damage**
- **Repairing Wires Is Costly, Adding Significantly to Ownership Costs**
  - **Study by the Naval Postgraduate School Estimated That the Navy Alone Spent $20 Million On Unscheduled Wiring Maintenance In 1999**
- **Negative Impact on Operational Readiness Rates**

WHY ?

- **Huge Volume Of Technical Data**

- **Skill Level Of The Maintenance Technicians Required To Trace Wires And Identify Systems**

THE ANSWER

- **AFRL-Initiated Program To Develop A Computerized Aircraft Wiring Maintenance Aid That Would Expedite Aircraft Wire Damage Assessment And Repair**
  - **F-15 Aircraft Chosen As The Test Aircraft**
  - **COTS Hardware/Software Used**
- **Four-Phase Program From 1989 – 1992 Developed The Required Tool**
- **Effort Documented in AFRL Technical Report WL--TR-92-3077, *Development of a Computerized Aircraft Wiring Maintenance Aid*, April 1992**

WIRING MAINTENANCE AID

- **Two Modes Of Operation - ABDR And Maintennce**
  - **Original Concept Was to Expedite Battle Damage Repair**
    - ➪ **Where Is The Plane Damaged**
    - ➪ **Maintenance Aid Provides Data On The Wires In That Area (Aircraft Zone)**
  - **Capabilities Expanded to Include Normal Maintenance Operations**
    - ➪ **What Aircraft System Has A Problem**
    - ➪ **What Is The Specific Problem**
    - ➪ **Maintenance Aid Provides Appropriate Connector Data**

IT WORKS!!!

- **Maintenance Aid Time Savings Capabilities Validated In Two ABDR Exercises**
  - **Serene Robins 00-02 Held at Warner Robins ALC in Feb 2000**
    - ➪ **Wire Assessment and Repair Work That Would Normally Have Taken 24 - 48 Hours Completed in 12 Hours Under Exercise Conditions**
  - **Joint Command ABDR Exercise Held At Davis Monthan AFB In Nov 1994**
    - ➪ **Team 1 Using Tech Orders Could Not Find Both Endpoints (Connector/Pin) Of Five Cut Wires In 5½ Hours**
    - ➪ **Team 2 Using The Maintenance Aid Found All Connectors/Pins In 35 Minutes**

CURRENT CAPABILITIES

- **Provides Tail Number-Specific Wiring Data For Every F-15**
  - **Wire Bundle Number**
  - **Wire Number**
  - **Aircraft System And Mission Criticality of That System**
  - **Connector And Pin Identification For Both Ends Of Wire**
  - **Connector Location (Aircraft Zone, Access Door)**
  - **Gauge**
  - **Wire Description**
  - **LRU**
- **Present Individual Wire Data In Various Formats**
  - **By Wire Bundle**
  - **By Connector**
- **Ability To Track A Given Wire Throughout The Aircraft**
- **Reduce Cost Of Ownership**

REDUCE COST OF OWNERSHIP

- **Naval Postgraduate School Study Included a Sensitivity Analysis of Navy Wire Repair Process**
- **Results**
  - **Labor Costs Associated With Troubleshooting / Identifying Wire Failures Only Are Estimated at $5.1 M - $31.4M, Depending on Assumed Labor Rates and Required Hours**
- **Computerized Aircraft Wiring Maintenance Aid Can Reduce These Costs at Least 50%**
  - **Annual Savings of $2.6M - $15.7M for Navy Only**
  - **Net Present Value of $29.9M - $185.4M for Navy Only, Based on 20 Year System Life and 5% Discount Rate**

WHERE IT CAN GO

- **Other Platforms**
- **Prognostic Capabilities**
  - **When Might A Given Wire Fail**
- **Expert System Capabilities**
- **Graphics Capabilities**
  - **Wiring Schematics**
  - **Visual Display Of Where Access Door Is Located On Aircraft**
  - **Visual Display Of Internal Component Configuration Behind Door**

CONCLUSIONS

- **Computerized Wiring Maintenance Aid Has Demonstrated Its Ability to Reduce Manhours Associated With Trouble Shooting Wiring Problems**

- **Reduction in Manhours Can Provide Significant Reductions in Total Ownership Costs As Well As Improved Readiness Rates**

- **Can Be Used With Any Platform**